TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35.U.S.C. 371	EXPRESS MAIL LABEL No EL 905055765 US	DATE December 10, 2001
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	U S APPLICATION NO 10/018041	

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/05468	June 14, 2000	June 15, 1999

TITLE OF INVENTION
IMAGE BINARIZATION METHOD

APPLICANT(S) FOR DO/EO/US
Belkacem Benyoub and Hicham El Bernoussi

Applicant herewith submits to the United States Designated /Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [X] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [X] A copy of the International Search Report (PCT/ISA/210)
   a. [X] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [] have been transmitted by the International Bureau
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. [X] A copy of the International Preliminary Examination Report (PCT/IPEA/409)
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [ ] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [X] A change of power of attorney and/or address letter.
16. [X] Other items or information:
    a. [X] a copy of the International Search Report (PCT/ISA/210)
    b. [X] a copy of the International Preliminary Examination Report (PCT/IPEA/409)
    c. [X] PCT application No. PCT/EP00/05468 was published in English under publication number WO 00/77718 on December 21, 2000.

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/05468 10/018041	June 14, 2000	June 15, 1999

17. [X] The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)-(5):

Neither international preliminary examination fee (37 CFR 1.482)

Nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO (1 492(a)(3)) $1,040.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO (1.492(a)(5) $890.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO(1.492(a)(2)) $740.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) (1.492(a)(1)) $710.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $ 100.00

CALCULATIONS PTO USE ONLY

ENTER APPROPRIATE BASIC FEE AMOUNT =	$---1040.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 C.F.R. 1.492(e)).	$0.00	

Claims	Number Filed	Number Extra	Rate	$	
Total Claims	4 - 20=	0	X $ 18.00	$ 0.00	
Independent Claims	2 - 3=	0	X $ 84.00	$ 0.00	
Multiple dependent claim(s) (if applicable)			+ $280.00	$ 0.00	
TOTAL OF ABOVE CALCULATIONS =				$ 1040.00	
Reduction by ½ for filing by small entity, if applicable				$ ---.00	
SUBTOTAL =				$ ---.00	
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Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$ 0.00	
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				charged	$

a. [X] A check in the amount of $1040.00 to cover the above fees is enclosed.

b. [ ] Please charge our Deposit Account No. 50-1145 in amount of $___ to cover the above fees. A copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-1145. A copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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Signature Marta E. Delsignore

December 10, 2001
Date

32,689
Registration No.

IMAGE BINARIZATION METHOD

The invention relates to a method of transforming a digital image having several gray levels into a binary image in which each pixel is coded over one bit. It applies most particularly to automatic mail processing machines. In the automatic processing of mail, it is usual to provide a camera between the unit for taking mail items from the stack and the unit for sorting these mail items, this camera producing a digital image with several gray levels of the face of each mail item on which the destination address of the mail is printed. This digital image having several gray levels is used to carry out automatic recognition of the characters of the address and subsequently automatic reading of the address so as to operate the downstream sorting unit.

The automatic character recognition processes are applied to binarized images, that is to say images in which each pixel is coded over a single bit. In the digital image with several gray levels, each pixel is generally coded over one byte, that is to say over eight bits.

Hitherto, to transform a digital image having several gray levels into a binary image, the mail processing sector has made use of processing by dynamic thresholding consisting in calculating, for each pixel of the digital image having several gray levels, the local contrast level within a certain neighborhood of this pixel, this contrast level making it possible to calculate a local threshold with which the gray level of the pixel is compared for the coding of the corresponding pixel in the binary image. For example, if the gray level of the current pixel is less than or equal to the local contrast level of this pixel, the corresponding pixel of the binary image is white and in the converse case it is black. The binary image therefore comprises only black or white pixels. There are other processes for binarizing a digital image having several gray levels, for example the static thresholding process according to which the gray level of each pixel of the image to be binarized is compared with a fixed threshold or else processes using operators such as the gradient, the Laplacian, the standard deviation, etc.

Within the postal mail sector, the characters printed on the mail items exhibit great variability which is due to the local practices of each country as regards the printing of addresses on mail items as well as to the use of different printing supports. It follows that by applying the same binarization process to a wide spectrum of mail items, a great diversity is obtained in the quality of the binary images. The latter do not always retain the original geometrical structure or the connectedness of the characters of the images having several gray levels. The interconnecting of the characters, when they are very close together, and their sinkage, when they are abnormally thick are not always taken into account in the binary images. Likewise, the weak contrasts which may constitute elements characteristic of the shape of the characters are not always recovered within the binary image whereas smudges on the character printing support may be recovered within the binary image.

The aim of the invention is therefore to propose a method for transforming a digital image having several gray levels into a binary image which remedies the drawbacks indicated above.

To this end, the subject of the invention is a method for transforming a digital image having several gray levels into a binary image in which each pixel is coded over one bit, which consists in applying, to each current pixel of the digital image having several gray levels, several different parallel binarization processes each delivering as output a binary value for this current pixel and in combining the binary values delivered by the various binarization processes for each current pixel of the digital image having several gray levels so as to obtain a resultant binary value constituting the corresponding pixel of the binary image.

This multiprocess approach allows the best account to be taken of the diversity of printing of the characters in the digital images having several gray levels of mail items. The combining of the binary values at the output of the binarization processes makes it possible to adapt the definitive coding of the pixel in the binary image as a function of the specific characteristics of the mail items to be processed.

The binarization processes can include bandpass processes of dynamic or static thresholding type, high-pass processes with the aid of computational operators of the differential type (gradient, Laplacian) and low-pass processes with the aid of computational operators of the integrator type.

According to a particular feature of the method according to the invention, these binarization processes can in part be carried out by a neural classifier. For each pixel of the digital image to be binarized, the neural classifier is supplied with a vector of values characterizing the environment of this pixel in this image and on the basis of this vector of characteristic values, the neural classifier produces a binary value for this pixel. The use of a neural classifier is particularly advantageous for processing very different spectra of mail items on one and the same machine. This is because it is sufficient to carry out learning phases for training the neural classifier on batches of mail items exhibiting the particular features of the diverse spectra of mail so as to construct so many sets of neuron weights for the neural classifier. By holding these various sets of neuron weights in memory in the automatic mail processing machine, it is possible easily to adapt the binarization procedure to mail items of a certain type by loading the set of neuron weights which best suits mail items of this type.

The method according to the invention and its implementation are described in greater detail hereinbelow and illustrated in the drawings.

Figure 1 depicts a schematic diagram of the method according to the invention.

Figure 2 illustrates a window of 9 × 9 pixels of a digital image having several gray levels.

The method for transforming a digital image having several gray levels into a binary image according to the invention is therefore more particularly intended to be implemented in an automatic mail processing machine.

Hereinbelow, a digital image having several gray levels will be regarded as being an image produced as a square grid of pixels with a specified density of pixels per millimeter, for example 8 pixels per millimeter in both directions. Each pixel of this image is for example coded over 8 bits and therefore with a total dynamic range of 256 gray levels.

Figure 1, the transformation of a digital image having several gray levels A into a binary image F is therefore achieved according to the method of the invention by the parallel application of several different binarization processes such as T1, T2, T3, performed in pipeline mode on the image A. Each binarization process delivers as output a binary intermediate image and the pixels of the binary images B, E, D respectively produced by the processes T1, T2 and T3 are combined in a decisive process T4 so as to obtain a resultant binary image F whose pixels are exclusively white or black.

An additional morphological filtering process T5 can advantageously be applied to the image F to produce an image G of better quality than the image F. In particular, this process T5 can make it possible to eliminate the white pixels or the black pixels from the image F both within the background and within the outline as well as from the boundaries between these two categories of pixel of the image.

Generally, each binarization process such as T1, T2 and T3 is an iterative process which is applied to all the pixels of the image A and we shall denote by P the current pixel of the image A which is being processed in the course of an iteration of a binarization process.

The binarization processes which can be paralleled are of the bandpass, high-pass or low-pass type. The binarization processes illustrated by Figure 1 are the static thresholding process such as T3 or the local contrast process by dynamic thresholding such as T2 which are two bandpass type processes. In the static thresholding process, the gray level of the current pixel is simply compared with a fixed threshold so as to assign the value 0 or 1, corresponding for example to a white pixel or a black pixel respectively, to the corresponding pixel in the binary image D. The principle of dynamic thresholding has already been set forth above.

The principle of the method according to the invention is to obtain, for each pixel of the image A, several binary values 1 or 0 produced in parallel by so many different binarization processes, that is to say the corresponding pixels of the images B, E, D, and to combine these binary values 1 or 0 so as to code the corresponding pixel of the binary image F to 1 or 0. It will be understood that this combining of the binary values makes it possible to favor this or that binarization process as a function of the type of mail items to be processed to obtain the resultant binary image F. This combining could also be based on the principle of majority voting.

In the method according to the invention, certain of the parallel binarization processes can be carried out by a neural classifier. As may be seen in particular in Figure 1, the output of the process T1 is the output of a neural classifier. To simplify the subsequent description, the expression neighborhood of a current pixel P in the image A will refer to a square matrix of pixels at the center of which the current pixel P is located. Figure 2 illustrates a neighborhood of the pixel P consisting of a square matrix of 9 × 9 pixels such as pixels 1 to 8.

The neural classifier can be of the MLP type (Multi Layer Perceptron) with one or more hidden layers. The principle of operation of this neural classifier is to translate into a binary value, a vector of data characterizing the environment of a current pixel P of the image A. By way of example, this neural classifier can have an input layer with 10 neurons to which are applied 10 data characteristic of a current pixel P which were extracted by computational primitives P0 to P9 detailed hereinbelow by way of non-limiting example.

The primitive P0 simply extracts the gray level of the current pixel P. This datum corresponds to one of the 256 gray levels and is coded on one byte.

The primitives P1, P2 and P3 respectively compute the average gray levels about the pixel P for different neighborhoods thereof in the image A, typically in matrices of 3 × 3 pixels, of 7 × 7 pixels and of 13 × 13 pixels.

The primitives P4 and P5 respectively compute the maximum deviation of the gray levels of the pixels in different neighborhoods of a pixel P in the image A, typically in matrices of 7 × 7 pixels and of 13 × 13 pixels.

The primitives P6 and P7 compute the standard deviation of the gray levels of the pixels in different neighborhoods of the pixel P, typically in square matrices of 7 × 7 pixels and of 13 × 13 pixels.

The primitive P8 computes the local contrast level in a neighborhood of the pixel P, typically a matrix of 13 × 13 pixels. Here, this primitive corresponds in part to the binarization process T2.

Finally, the primitive P9 extracts the gradient over four directions in a neighborhood of the pixel P, typically a matrix of 3 × 3 pixels.

The weights of the neurons of the neural classifier are obtained by learning according to the method of backpropagation from synthesized binary images. These images are synthesized so as to orient the network of neurons in the direction desired; for example, to avoid sinking the thick characters, one uses a high proportion of synthesized images which represent thick characters; in the nominal case these images are in proportion representative of the actual mail. It is advantageous to carry out several learning phases so as to construct several sets of weights for the neurons of the classifier so that each set of weights is more particularly adapted to mail items to be processed of a certain type. The parallel processes T1, T2 and T3 can be implemented within an ASIC circuit and are all parametrizable. In the phase of use in a mail processing machine, various thresholding parameters of the processes T2 and T3, various computational parameters of the primitives P0 to P9 and various sets of weights of the neurons of the neural classifier of the process T1 can be held in memory in the automatic mail processing machine so that it is conceivable to be able to recover them selectively so as to parametrize the ASIC circuit before commencing a binarization procedure on a particular batch of mail items.

CLAIMS

1. A method for transforming a digital image (A) having several gray levels into a binary image (F) in which each pixel is coded over one bit, is one which consists in applying, to each current pixel (P) of the digital image having several gray levels, several different parallel binarization processes (T1, T2, T3) each delivering as output a binary value for this current pixel and in combining (T4) the binary values delivered by the various binarization processes for each current pixel of the digital image having several gray levels so as to obtain a resultant binary value constituting the corresponding pixel of the binary image.

2. The method as claimed in claim 1, in which the output of one of the binarization processes (T1) is the output of a neural classifier.

3. The use within an automatic mail processing machine, of a neural classifier for transforming a digital image having several gray levels into a binary image.

4. The use of a neural classifier as claimed in claim 3, in which the neural classifier has undergone several learning phases by backpropagation in order to construct so many different sets of weights for the neurons of the neural classifier, these various sets of weights being held in memory in the automatic mail processing machine, and in which these sets of weights can be selectively recovered so as to binarize digitized images for a specified batch of mail items.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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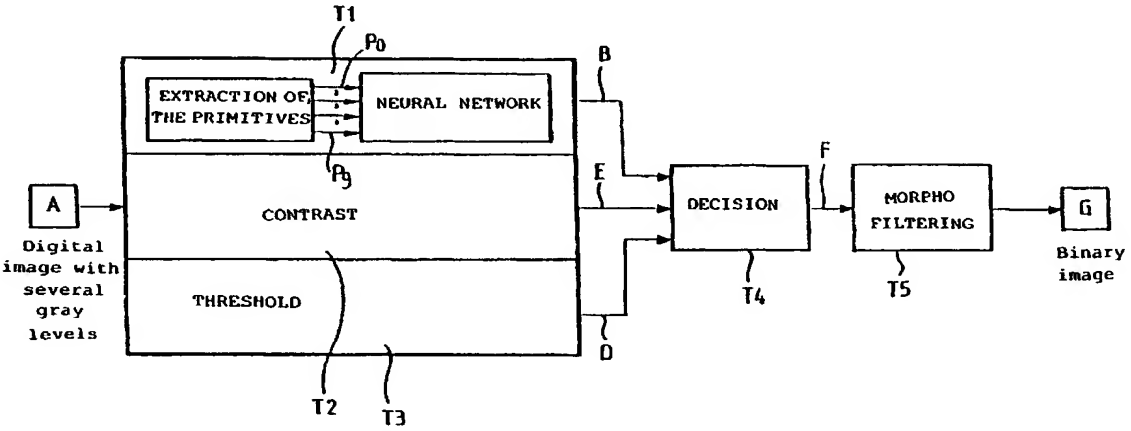
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: IMAGE BINARIZATION METHOD



(57) Abstract: The method for transforming a digital image (A) having several gray levels into a binary image (F) in which each pixel is coded over one bit, consists in applying, to each current pixel (P) of the digital image having several gray levels, several different parallel binarization processes (T1, T2, T3) each delivering as output a binary value for this current pixel and in combining (T4) the binary values delivered by the various binarization processes for each current pixel of the digital image having several gray levels so as to obtain a resultant binary value constituting the corresponding pixel of the binary image.

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FIG_1

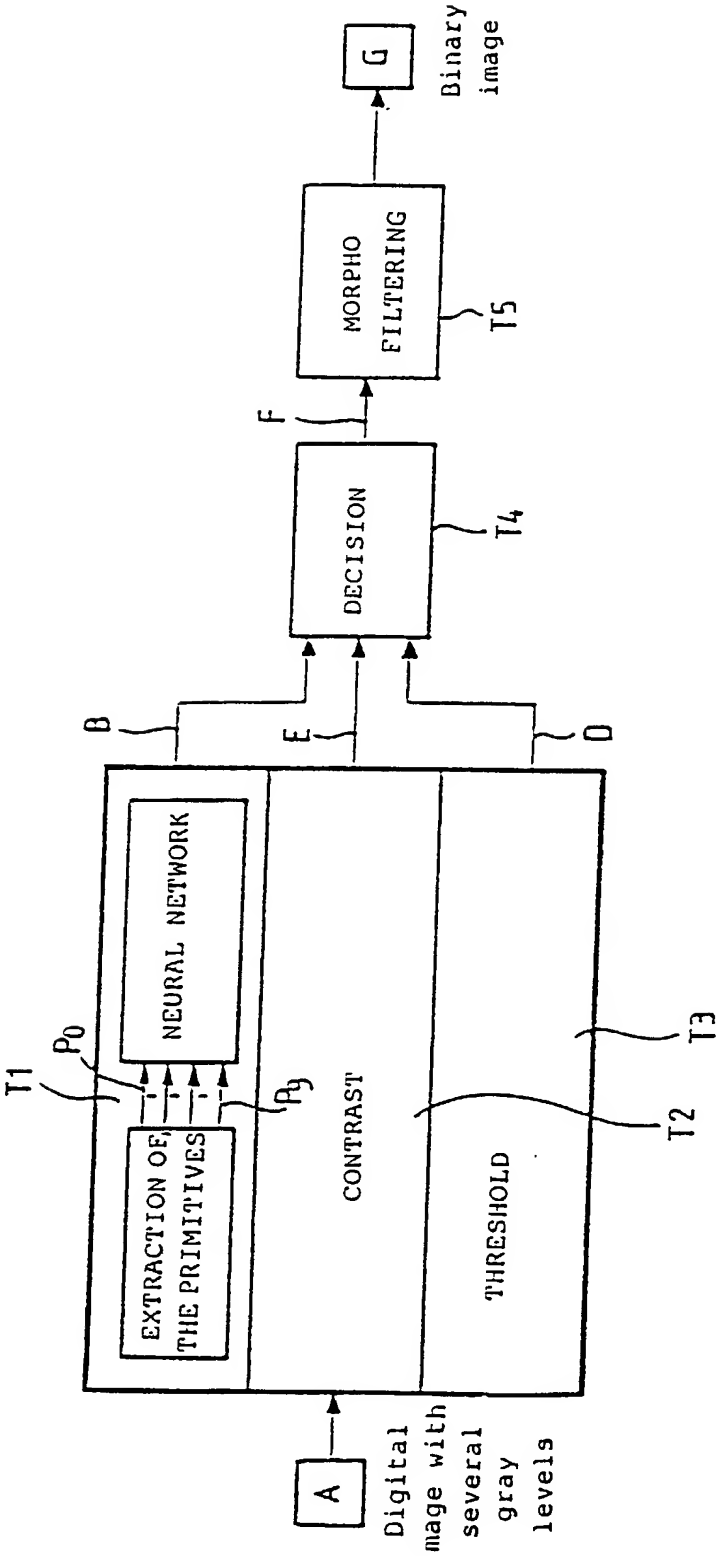
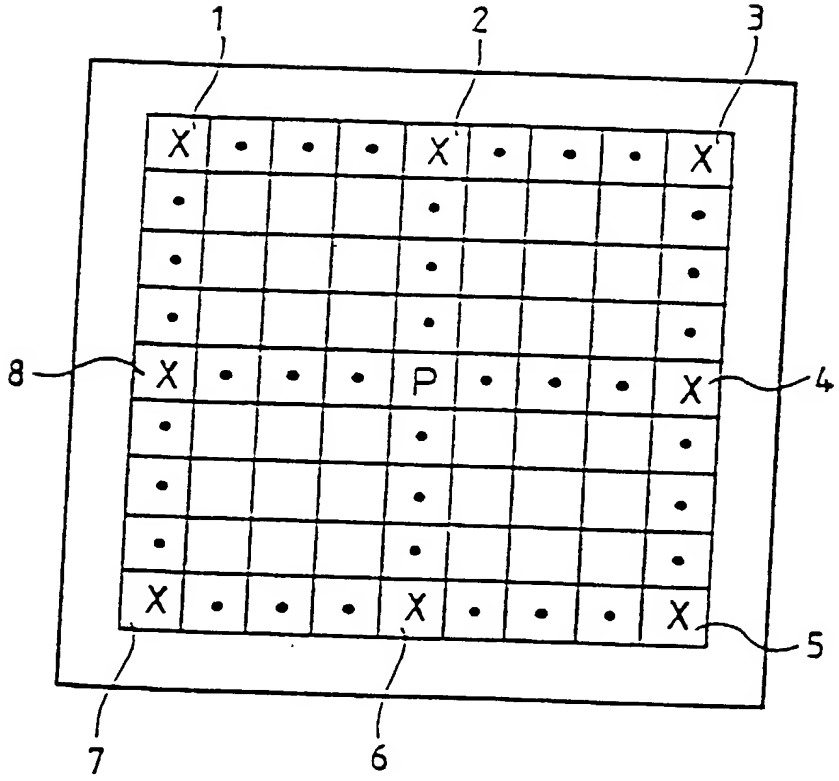

A
Digital image with several gray levels
G
Binary image
MORPHO FILTERING
T5
F
DECISION
T4
B
E
D
NEURAL NETWORK
EXTRACTION OF THE PRIMITIVES
CONTRAST
THRESHOLD
T1
P0
Pj
T2
T3

FIG_2



COMBINED DECLARATION AND POWER OF ATTORNEY

(Original, Design, National Stage of PCT, Divisional, Continuation or C-I-P Application)

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

IMAGE BINARIZATION METHOD

This declaration is of the following type:

[] original
[] design
[X] national stage of PCT/EP00/05468.
[] divisional
[] continuation
[] continuation-in-part (C-I-P)

the specification of which: *(complete (a), (b), or (c))*

(a) [] is attached hereto.
(b) [X] was filed on 12/10/01_ as Application Serial No. 10/018,041 and was amended on *(if applicable).*
(c) [] was described and claimed in PCT International Application No. _____ filed _____ on and was amended on *(if applicable).*

Acknowledgment of Review of Papers and Duty of Candor

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the subject matter claimed in this application in accordance with Title 37, Code of Federal Regulations § 1.56.

[] In compliance with this duty there is attached an information disclosure statement. 37 CFR 1.98.

Priority Claim

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT International Application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT International Application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application on which priority is claimed

(complete (d) or (e))

(d) [] no such applications have been filed.

(e) [X] such applications have been filed as follows:

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION			
COUNTRY APPLICATION NO	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
			[] YES NO []
			[] YES NO []
			[] YES NO []
ALL FOREIGN APPLICATION[S], IF ANY, FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION			
France N 99 07 545	15/6/1999		[X]YES NO []
			[] YES NO []
			[] YES NO []

Claim for Benefit of Prior U.S. Provisional Application(s)

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

Provisional Application Number	Filing Date

Claim for Benefit of Earlier U.S./PCT Application(s) under 35 U.S.C. 120

(complete this part only if this is a divisional, continuation or C-I-P application)

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose information as defined in Title 37, Code of Federal Regulations, § 1.56 which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PCT/EP00/05468	14/6/2000	pending
(Application Serial No)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No)	(Filing Date)	(Status) (patented, pending, abandoned)

Power of Attorney

As a named inventor, I hereby appoint Gerald Levy, Reg. No. 24,419; Ronald E. Brown, Reg. No. 32,200; Marta E. Delsignore, Reg. No. 32,689; John Gulbin, Reg. No. 33,189; Lindsay Adams, Reg. No. 36,425; and Michael P. Stanley, Reg. No. 47,108, of the firm of Pitney, Hardin, Kipp & Szuch, with offices at 685 Third Avenue, New York, New York 10117-4024, as attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith

SEND CORRESPONDENCE TO:	DIRECT TELEPHONE CALLS TO:
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00

FULL NAME OF SOLE OR FIRST INVENTOR	LAST NAME Benyoub	FIRST NAME Belkacem	MIDDLE NAME	
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DATE 19 mars 2002	SIGNATURE OF INVENTOR			

2-00

FULL NAME OF THIRD JOINT INVENTOR, IF ANY	LAST NAME El Bernoussi	FIRST NAME Hicham	MIDDLE NAME	
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POST OFFICE ADDRESS	POST OFFICE ADDRESS 17, rue Vasco de Gama	CITY Paris	STATE or COUNTRY France	ZIP CODE F-75015
DATE 19 mars 2002	SIGNATURE OF INVENTOR			

FULL NAME OF FOURTH JOINT INVENTOR, IF ANY	LAST NAME	FIRST NAME	MIDDLE NAME	
RESIDENCE & CITIZENSHIP	CITY	STATE or FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP	
POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE or COUNTRY	ZIP CODE
DATE	SIGNATURE OF INVENTOR			

FULL NAME OF FIFTH JOINT INVENTOR, IF ANY	LAST NAME	FIRST NAME	MIDDLE NAME	
RESIDENCE & CITIZENSHIP	CITY	STATE or FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP	
POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE or COUNTRY	ZIP CODE
DATE	SIGNATURE OF INVENTOR			

FULL NAME OF SIXTH JOINT INVENTOR, IF ANY	LAST NAME	FIRST NAME	MIDDLE NAME	
RESIDENCE & CITIZENSHIP	CITY	STATE or FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP	
POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE or COUNTRY	ZIP CODE
DATE	SIGNATURE OF INVENTOR			

Check proper box(es) for any added page(s) forming a part of this declaration

[] Signature for ninth and subsequent joint inventors. Number of pages added _____.

[] Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. Number of pages added _____.

[] Signature for inventor who refuses to sign, or cannot be reached, by person authorized under 37 CFR 1.47. Number of pages added _____.